

The Role of Trust in Financial Sector Development

Biagio Bossone

How does incomplete trust shape the transaction costs in trading assets? And how does it affect resource allocation and pricing decisions from rational, forward-looking agents?



Summary findings

In any economic environment where decisions are decentralized, agents consider the risk that others might unfairly exploit informational asymmetries to their own disadvantage.

Incomplete trust, especially, lies at the heart of financial transactions in which agents trade current real claims for promises of future real claims. Agents thus need to invest considerable resources to assess the trustworthiness of others with whom they know they can interact only under conditions of limited and asymmetrically distributed information.

Thinking of finance as the complex of institutions and instruments needed to reduce the cost of trading promises among anonymous individuals who do not fully trust each other, Bossone analyzes how incomplete trust shapes the transaction costs in trading assets, and how it

affects resource allocation and pricing decisions from rational, forward-looking agents.

His analysis leads to core propositions about the role of finance and financial efficiency in economic development.

He recommends areas of financial sector reform in emerging economies aimed at improving the financial system's efficiency in dealing with incomplete trust. Among other things, the public sector can improve trust in finance by improving financial infrastructure, including legal systems, financial regulation, and security in payment and trading systems.

But fundamental improvements in financial efficiency may best be gained by eliciting good conduct through market forces.

This paper — a product of the Financial Economics Unit, Financial Sector Practice Department — is part of a larger effort in the department to study the links between financial sector and economic development and improve financial sector policy reforms. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Elena Mekhova, room MC9-622, telephone 202-458-5984, fax 202-522-2031, Internet address emekhova@worldbank.org. Policy Research Working Papers are also posted on the Web at <http://www.worldbank.org/html/dec/Publications/Workpapers/home.html>. The author may be contacted at bbossone@worldbank.org, October 1999. (34 pages)

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by

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“In a society with growing choices, and one where the depth of information is potentially infinite, the highest value will be given to the source whose information is most dependable” (T. Rosentiel and B. Kovach).¹

Part I. Finance, information, and trust

I.1 Asymmetric information and incomplete trust

Although the importance of information imperfections in economic analysis had been early recognized by some scholars (Arrow, 1953; Stigler, 1961; Brunner and Meltzer, 1971; Alchian and Demsetz, 1972), it was only after research started systematically to look at the implications of the asymmetric distribution of information across the agents, well into the eighties, that information has become central to the study of finance. The essence of the Asymmetric Information (AI) research program in finance is captured by Greenwald and Stiglitz' (1987) emphasis on “...the need for a more radical departure from the neoclassical framework, and for a much deeper study of the consequences of imperfections in capital markets, imperfections which can be explained by the costs of information” (p. 123).

AI characterizes a situation where one side of the market has better information than the other on options and incentives, and the less informed side is aware of its informational disadvantage. AI in financial markets creates inefficiencies because the incentives problems due to adverse selection and moral hazard of fund-users diminish the net returns to financial investors. Such incentive problems reduce the opportunity for risk sharing in capital markets and may give rise to fund-rationing as financial investors choose to turn away observationally equivalent borrowers at a fixed rate of interest, or discriminate among borrowers with respect to the terms of the financial agreements.

By challenging the assumption of perfect and costless information, AI theory has derived important implications for understanding rational behavior under risk, also shedding light on the principal-agent problems underpinning a large variety of real-world agent interactions. In particular, AI theory has laid the ground for a micro-economically founded interpretation of the role of financial intermediaries (especially banks) as reducing risks on financial investment through information processing, and has laid out fundamental principles for designing appropriate incentives to limit the inefficiencies from information asymmetries.

Yet, the existence of information asymmetries is only part of the more general problem of uncertainty confronting rational choices in a world with time. Post Keynesians radically criticize AI (New Keynesian) theorists for eluding the question of how agents form their decisions in the absence of risk mapping information, by assuming a (typically neoclassical) *ergodic* world where well-defined and known probability distributions of future contingencies replace Keynesian (fundamental) uncertainty with manageable risk.² Moreover, Post Keynesians deny that the implications of AI theory say anything on economic cycles and crises that is not already embodied in Keynes' liquidity-preference theory.

Recognizing that information is intrinsically limited and asymmetric, and that diversification and specialization of activity require agents to rely on the services of others, this study looks at the implications for intertemporal resource allocation and asset prices of that particular form of uncertainty deriving from lack of full trust - or *incomplete trust* - among agents. Incomplete trust can be defined as *the agents' awareness that others may seek to pursue inappropriate gains either through deliberately reneging on obligations due on earlier commitments, or by hiding information relevant to transactions*. More in general, and considering that agents operate under uncertainty, the concept of trust may involve the *agent's judgement that her counterparty to a contract would make all reasonable efforts to deliver on the contract*.³

Incomplete trust lies at the core of AI. Whereas, in principle, full trustworthy agents can trade at zero (or low) cost, in spite of AI, since each can (risklessly) take everybody else's word at face value, *symmetric* information is not possible without assuming full trust: full informational symmetry holds only if individuals always reveal their true inner motives, that is, if they are fully trustworthy.

As the risk of unfair exploitation of asymmetries grows real, what becomes important to the agents is to be able to benefit from asymmetric information while managing their mutual trust gaps. More information is searched by the agents not so much to reduce information asymmetries, as to see whether and how they can trust each other, some agents specialize in bridging these gaps, and institutions evolve to reduce the effects of distrust by improving incentives to honest or fully informative behavior and contractual performance. Resources invested in activities aimed to reduce the inefficiency costs from incomplete trust affect transactions and the price of commodities and assets exchanged among the agents

The problem of incomplete trust is particularly crucial in financial transactions, where anonymous agents trade current real resource claims in exchange for *promises* to receive back real resource claims at some given point in future. Traders of promises need to ascertain whether their counterparties do their best to keep to their promises, and whether they are able to use information efficiently to this end.

In small communities of societies in early stages of economic development, with strong ties among members, financial transactions even with long-term obligations can take place at reasonable costs.⁴ In contrast, in larger and more complex communities, where interpersonal bonds are weakened by agent anonymity and information asymmetries are embedded in largely decentralized-decisions contexts, financial transactions can be undertaken only if institutions specialize in activities to limit the costs of incomplete trust and if they are supported by appropriate infrastructure.

Specializing means investing in information to select trustworthy and efficient fund-users, monitoring their behavior, adopting incentives to elicit honest behavior, thus creating a reputation of their own for being good *bridges of trust* between anonymous agents.⁵ Anonymous financial-service users, on their part, invest more to identify reliable and efficient bridges of trust with other agents, so as to reduce the costs from AI separating them.

The role of specialized institutions is complemented by infrastructural components (e.g., legal system, regulation and supervision, trading technologies, incentives and enforcement mechanisms) aimed to strengthen commitment compliance from individual agents.

This study analyzes how incomplete trust shapes transaction costs and – hence - asset allocation, and how the financial system and public policy respond to the problem of incomplete trust. The study is structured in two parts. In part I, section I.2 discusses the role of money and financial assets under incomplete trust, develops a model to determine the impact of financial efficiency on intertemporal resource allocation, asset prices and capital accumulation, and draws implications for the relationship between finance and economic development. Part II focuses on policy issues: sections II.1 and II.2 discuss how financial intermediaries can enhance trust by accumulating reputational capital, and section II.3 identifies policies to improve the efficiency of the financial system in dealing with incomplete trust.

I.2 Information and trust in intertemporal resource allocation and pricing⁶

In a world where transactions were carried out simultaneously, money would be redundant. Money becomes necessary as a store of value and a transaction device only when time is introduced in the exchange process and the simultaneity assumption is dropped.

The link between time and money rests on a twofold argument. The first - following the Keynesian-Hicksian tradition - relates to uncertainty and market incompleteness: to the extent that transactions are effected sequentially, the future is uncertain, and markets do not exist for all possible contingencies, the agents hold reserves of purchasing power stored in instruments that can easily be exchanged for real commodities as needs arise.

The generally accepted analytical implication of the uncertainty argument is that under the assumption of complete markets (as in a typical Arrow-Debreu setting), and notwithstanding the existence of time, money becomes as irrelevant as in timeless models. Gale (1978) has proved this argument flawed by showing that, even with complete markets, money serves as a store of value if the agents do not trust each other in their commitment to fulfill their contract terms.⁷

Incomplete trust is thus the second reason for tying money to time.⁸ Even if all agents had perfect forecast capability of future contingencies, their anticipation that others might renege on obligations, or cheat on the quality of whatever they supply, would by itself create the need to adopt some means that can store value over time and be equally acceptable to all agents in the exchange process. Such means must be easily *recognizable* by all participants, so that its information content is visible to all at a low cost.⁹ This requirement would not be necessary in a world of fully trustworthy individuals, even if information were distributed symmetrically among them, as each would be taken at her own word as to the value of whatever she supplies in the exchange process. Of course, individuals' uncertainty of the future would still make them hold stores of value for precautionary reasons, or give them incentives to hold assets for speculative purposes.

Under incomplete trust, information is necessary for the agents to assess their mutual trustworthiness as well as the *quality* of the assets submitted to trade.¹⁰ In such a case, assets differ from one another as to their power to convey information on their quality and the trustworthiness of their suppliers: some assets are relatively more costly than others for use in the exchange and payment process, since their acceptability requires more information and involves longer search activity than others. In a competitive equilibrium setting, the asset return structure should thus reflect the transaction costs underlying each asset's trading, ultimately associated with the quality of the assets and the trustworthiness of those for whom they represent a liability.¹¹ On their side, asset holders should hold more of an asset up to where its return equals its marginal utility net of what is lost due to the (asset-specific) transaction costs. In fact, one way to look at the financial system in a decentralized-decisions context is to consider its role to reduce the transaction costs associated with incomplete trust.

I.2.1 A model of incomplete trust in asset trading

The model used in this study is an integrated version of Bossone's (1997). As in the former version, the core of the model consists of deriving a general form of optimal demand functions for assets trading in a multi-sector economy, under incomplete trust and uncertainty. In the following, the first step will be to define the rationale for, and the mechanism of, asset price discounting in an incomplete trust context. As a second step, the utility content of money and

financial assets will be formalized. An optimal intertemporal decision framework under general equilibrium will then be used to study the effects of financial system innovations and output variability on resource allocation and pricing.

Asset price discounting

Assume an asset Q - say, a financial security - earning a nominal interest rate r^Q .¹² With incomplete trust, asset Q may be purchased (sold) at market price $p^Q (= 1 / r^Q)$ plus (minus) a unit premium (discount) specific to the asset, d^Q . To formalize the discount factor d^Q , define first the asset trading context under incomplete trust.

An holder of Q who wishes to realize the asset advertises its sale on the market and submits an ask-price for it.¹³ If the holder is fully trusted by *all* other agents, no prior assessment is necessary from potential buyers and the transaction costs involved are smaller than under incomplete trust since Q is equally acceptable to all agents and against all other assets. With incomplete trust, on the other hand, sellers need to undertake longer and costlier processes for achieving *best price* sales as: *i*) different agents submit different bid-prices for the same asset due to their different perceptions of asset quality, and *ii*) not all agents stand ready to buy assets on sale due to the assets' limited acceptability in trade. Also, *iii*) higher costs are incurred by the agents to assess their mutual trustworthiness as well as the quality of the asset traded. Lastly, *iv*) assets with different characteristics bear different information costs.

Under incomplete trust, one may assume that the shorter the time available to the holder for realizing the asset, and the lower the asset's acceptability in trade, the larger is the cost that the holder must be willing to bear in order to raise the needed liquidity. Such a cost takes the form of a discount on the asset market price that the seller offers to potential buyers. The rationale for price discounting rests on two factors: a) risk-averse agents are reluctant to trade assets whose *true* value they know with certainty against assets with uncertain or unknown value to them; b) even if some agents possess sure knowledge of the true value of the asset, they consider that others might not share the same knowledge thereby introducing frictions in the indirect exchange of the asset.

The time factor plays here a crucial role: with incomplete trust and a given financial structure (as characterized by institutional and legal arrangements, range and quality of intermediaries, and transaction technologies), each asset is characterized by its own *optimal transaction time*. This is the minimum time required of the asset-holder to maximize the net proceeds from the asset sale, including as such the time it takes the buyer to assess the

trustworthiness of the seller, the quality of the asset, the asset's acceptability in indirect exchange, as well as the time necessary to complete the transaction.¹⁴

Operationally, the optimal transaction time can be defined as the interval necessary for the seller to realize the asset at its current market value. The proceeds from optimal asset sale equal such a price net of the minimum asset-specific (unit) transaction cost d^{Q^*} , involved in completing the sale in the given trading context. Thus, *suboptimal* sales that take place at discounts on the asset market price greater than the minimum transaction cost, and occur when the asset must be realized within a time span shorter than its optimal transaction time. Discount factor $d^Q \geq d^{Q^*}$ can thus be formalized as a function of:

1. the optimal transaction time interval, Δt_Q^* : the longer the latter, the larger the discount at which Q must trade to shorten the sale time; and
2. the time interval, Δt_Q^0 , available to Q 's holder to realize the asset: for $\Delta t_Q^0 < \Delta t_Q^*$, the shorter the former vis-à-vis the latter, the larger the discount at which Q sells.

Expectations of higher output variability affect the price discount factor by shortening Δt_Q^0 . Thus,

$$(1) \quad d_t^Q = d^Q (1 - \Delta t^0(\sigma_t^{\rightarrow} | w_t) / \Delta t_Q^*(\Psi))$$

where $(\sigma_t^{\rightarrow} | w_t) = {}_tE[\beta^{t+i} \sigma_{t+i} | w_t]_{i=1}^{\infty}$ reflects the agent's expected (time weighted) average variability of consumption from date t onward, conditional on signal w_t . The conditional relation of σ^{\rightarrow} on w is such that the former increases as w approaches one. Signal $w \in (0,1)$ varies directly with the uncertainty perceived by the agents in the economy (see Appendix IV). $\Psi \in \mathbb{R}^+$ indicates the level of *efficiency* of the underlying financial system, defined in this context to reflect the financial system's capacity to reduce transaction costs related to incomplete trust through institutions and infrastructure (e.g., markets, technologies, regulations, and enforcement mechanisms) for the intermediation of financial resources. For our purposes, function (1) can be simplified as

$$(1a) \quad d_t^Q = d^Q(\sigma_t^{\rightarrow} | w_t, \Psi) \quad d'_{\sigma} > 0 \quad d'_{\Psi} < 0$$

The effect of the financial efficiency indicator is such that, other conditions being equal, price discount factors for the same assets are larger in less efficient financial systems, that is, assets' optimal transaction times are longer under lesser financial efficiency. As a result, all extra discounts with respect to d^{Q^*} on suboptimal sales would be larger. Note that for each Q , the

variable and state-contingent price discount would be determined according to the following conditions:

$$0 \leq d \leq 1$$

$$d = d^* \quad \text{if } \Delta t^o > \Delta t^*$$

$$d \rightarrow 1 \quad \text{if } \Delta t^o / \Delta t^* \rightarrow 0$$

Also, it is assumed that $d = d^* = 0$ if $\Delta t^* = 0$, that is, perfectly liquid assets trade at zero discount. In the extreme, where no financial system existed and Ψ approached zero, trading most assets would present no economic convenience. On the other hand, financial technological and institutional development (i.e., a higher Ψ) increases safety and speed of asset trading - and hence the degree of trust that agents place in asset trading - and reduces asset optimal transaction times. Note, thus, that the concept of *financial efficiency* as here defined involves that of *safe* trading as well.

Asset utility

In this model, money and financial assets are vehicles used for transferring consumption decisions across time, to the point where future (contingent) consumption yields the highest expected marginal utility. They transfer such decision at different speed, or transaction costs. The structure of such costs is, as discussed above, asset specific, while their scale is determined by the overall efficiency of the financial system.

Assets produce *utility* in terms of their power to make consumption accessible to their holders when and as needed. Utility varies positively with the consumption accessible through the asset, and negatively with the cost of liquidating the asset. If an agent holds an asset for a period during which she might incur income shocks, she could use that asset as an option to be exercised at any point of the period to avert (or limit) consumption losses. To estimate the option's current value, the agent needs to conjecture the probability of having to exercise the option (i.e., realize the asset) at each future date of the holding period and at a given cost. Such probability depends on the agent's knowledge of the distribution of future possible shocks, and on her use of current information to anticipate future shocks.

The probability is defined as follows. Consider a discrete and infinite time horizon $[0, \infty)$, and call $s_\tau^c \in S \subset R_c \otimes R_\tau^+$ the date-event whereby at any instant prior to τ the agent expects a consumption shock to be received at τ and mobilizes her resource endowments (that could otherwise be invested) to support consumption. Let s^{-c} be the complement of s^c in S , and let

$w_t \in (0,1), \forall t < \tau$, be an appropriate transformation of current information $w'_t \in \Omega_t$, (see Appendix IV) where Ω_t is the information set available to the agent at t . Finally, consider space $\Theta = \{pr(s^c = s^c_{\tau>t} | w_t), 0 \leq pr(\cdot) \leq 1 \text{ and } pr(s^c = s^c_{\tau>t} | w_t) + pr(s^c = s^c_{\tau>t} | w_t) = 1\}$, wherein at every date t each agent attaches a probability of occurrence to future date-events $s^c_{\tau+1}$'s, conditional on signal w_t .¹⁵ The signal is such that the probability of occurrence of date-event $s^c_{\tau>t}$ increases as w_t approaches one, that is, $\lim_{w_t \rightarrow 1} [pr(s^c = s^c_{\tau} | w_t) = 1] = 1$. As clarified in Appendix IV, w_t approaches one as uncertainty in the economy is perceived to increase.

The marginal utility of Q at t , conditional upon current information, can thus be constructed as the present value of the marginal utility from the stream of future contingent consumption accessible through the asset, net of the marginal utility lost to price discounts from asset liquidation:

$$(2) \quad u'(Q_t) = u'(Q_t | w_t) \\ = \sum_{\tau=t}^{\infty} \beta^g \{ [1 - d^Q_{\tau}(\sigma^{\tau}_{\tau} | w_t, \Psi)] \cdot E[u'(P^Q_{\tau} Q_t / p^c_{\tau}) \prod_g R^Q_g] pr(s^c = s^c_{\tau} | w_t) / \sum_{\tau} pr(\cdot) \}$$

where:

the time subscript $g = \tau - t$ is used for the compound interest factor

$P^Q_{\tau} Q_t / p^c_{\tau}$ is the consumption attainable at τ with Q -holdings valued at their t -dated price (note that expected future changes in the price of Q are incorporated in Q 's return);

p^c is the price of (composite) consumption commodity C

$R = 1 + r^Q - \pi$ is the gross real rate of return on asset Q and π is inflation.

Note that $d^Q = 0$ for perfectly liquid assets, and that for given values of Q , r^Q , p^c , and β , different combinations of d^Q and $pr(\cdot)$ yield different values of $u'(Q)$ (see Appendix III).

Operationally, relation (2) could be said to represent the expectation of the liquidity services provided by the asset to its holder during its holding period and contingent upon future states of nature. Note also that innovations in financial efficiency increase the marginal utility of Q by reducing its discount factor. Finally, an increase in w reduces Q 's marginal utility by increasing both the probability and the size of suboptimal sales (which increases Q 's discount factor).

1.2.2 Asset allocation and prices under incomplete trust

To determine the individual resource allocation choices when (trust-related) transaction costs are incorporated into the agents' decision-making process, assume an economy with three sectors - households, government and firms -, one composite commodity C for consumption expressed in real terms, and three assets expressed in nominal terms: monetary asset L , government bond B , and corporate financial security A .

Firms are owned by the households. Firms use capital K to produce nominal output Y^0 .¹⁶ Firms sell output at price p^C and turn their income to households (Y^h). Households also receive government income transfer g and pay out lump-sum taxes t to the government. The government finances income transfers via taxation and bond issues to the households.

Households have well-behaved utility functions with regular shape throughout their domain, i.e., with $u'(\cdot) > 0$ and $u''(\cdot) < 0$ yielding positive risk aversion, and with $u'''(\cdot) > 0$ ensuring that changes in the variance of consumption affect the agent's expected marginal utility.

Asset L is a non-interest bearing instrument issued by the government and accepted by all the agents as a means of exchange in force of a government legal restriction; thus, it trades at zero transaction costs. In every period, the households enter the goods market with a predetermined amount of L .

Bond B is a default-free (government-guaranteed) debt instrument, earning nominal interest r^B and issued by the government. Its supply $B^0 = g - t + rB_{-1}^0 + B_{-1}^0$ is determined as the state sector borrowing needed to finance the current fiscal deficit and the interest expenditure on outstanding bonds. Bond B trades at market price p^B and may be used by the households either as for storing value or in indirect exchange at a discount since, unlike L , it is not covered by a legal restriction on circulation as a means payment.¹⁷ In light of the government guarantee, however, such discount is small and supposed to be constant over time and across states of nature.

Asset A is a (risky) corporate bond issued by firms to finance capital acquisition. Its supply A^0 is placed with the households and is determined at the point where the marginal efficiency of technology equals the marginal cost of funds. Asset A is exchanged in the financial market at price p^A and earns nominal interest $r^A (= 1/p^A)$. It is used as a store of value and it can (in principle) be used also as a medium of exchange, although its indirect trade takes place at a discount much larger than B 's due to the absence of guarantees on its quality and of legal restrictions on its use.

In the exchange process, at each date, the infinitely-lived h -th household ($h=1, \dots, H$) uses its earnings to finance current consumption and/or to add to its wealth stock. The household derives

utility *directly* from current consumption and *indirectly* from asset holdings. With money and financial assets defined as future consumption options conditioned by transaction costs, the household maximizes at each date of its time horizon a composite utility function based on the utility delivered by current consumption, and the utility produced by asset holdings.

The household thus orders its preferences across consumption commodities and (money and financial) assets according to a strictly quasi-concave, time-separable utility function $U: \mathbb{R}^4 \rightarrow \mathbb{R}^+$ defined as $U=U(C,L,B,A)$. The household's plan at date t is thus to maximize:

$$(3) \quad U^H = \underset{C,L,B,A}{\text{Max}} \quad {}_tE \sum_{\tau=t}^{\infty} \beta^{\vartheta} [U(C_{\tau}^h, L_{\tau}^h, B_{\tau}^h, A_{\tau}^h)] \quad 0 < \beta < 1, \vartheta = \tau - t$$

subject to the intertemporal constraint reported in Appendix I.:

$$(4) \quad p_t^C C_t^h + z_t^h \leq Y_{Nt}^h + \sum_{Q=B,A} r_{t-1}^Q P_0^Q Q_{t-1}^h \\ + \sum_Q [d_t^Q \max(0, P_{t-1}^Q Q_{t-1}^h - P_{t-2}^Q Q_{t-2}^h) - d_t^Q \max(0, P_{t-2}^Q Q_{t-2}^h - P_{t-1}^Q Q_{t-1}^h)]$$

$$(5) \quad C, L, B, A \geq 0$$

$$(6) \quad \lim_{\tau \rightarrow \infty} L_{\tau} = \lim_{\tau \rightarrow \infty} B_{\tau} = \lim_{\tau \rightarrow \infty} A_{\tau} = 0$$

with $d^Q > 0$ if $\Delta t_Q^* = \tau - (\tau - 1) = 1 > \Delta t_Q^0$ (suboptimal sale) and where:

$$z_{\tau}^h \text{ is household saving and is defined as } z_t^h = L_{\tau}^h - L_{\tau-1}^h + \sum_Q (P_{\tau}^Q Q_{\tau}^h - P_{\tau-1}^Q Q_{\tau-1}^h);$$

$Y_N^h = Y^h + g^h - t^h$ is disposable income;

$\sum_Q r_{t-1}^Q P_0^Q Q_{t-1}^h$ is the interest income received from last period's Q -holdings;

P_0^Q is the purchase price of Q ; and

the two terms in $d^Q \max(\cdot)$ represent, respectively, the eventual gain/loss from buying/ selling asset $Q (=B, A)$ at a discount.

The solution to the household plan (see Appendix I) requires that at date t , for given current and expected values of σ, β, π, r^B and r^A , the household selects for each date $\tau \geq t$ an allocation $(C_{\tau}^{H*}, L_{\tau}^{H*}, B_{\tau}^{H*}, A_{\tau}^{H*})$ that satisfies the optimal intra-date rule

$$(7) \quad u'(C_{\tau}^{H*})(p_{\tau}^C)^{-1} = u'(L_{\tau}^{H*}) = u'(B_{\tau}^{H*})(p_{\tau}^B)^{-1} = u'(A_{\tau}^{H*}, \Psi | w_{\tau})(p_{\tau}^A)^{-1} = \mu_{\tau}$$

Rule (7) requires each household to equate at every instant the *weighted* marginal utilities derived from allocating the marginal resource unit to the available consumption commodities and assets (weighted with the inverse of their own current market price). For given expectations of future shocks to consumption, rule (7) ensures that the costs of mobilizing resources to absorb those shocks are minimized since the underlying optimization model incorporates the probability of incurring such costs (relation (2)). At each date, prices in each market must be such that rule (7) holds across all households under the following market clearing conditions:

$$(E1) \quad \sum_h C^h = Y^0 = \sum_h Y^h$$

$$(E2) \quad \sum_h L^h = L^0$$

$$(E3) \quad \sum_h B^h = B^0$$

$$(E4) \quad \sum_h A^h = A^0$$

From rule (7) it is immediately evident that a lower Ψ implies at the margin a lower utility of the illiquid asset. Equilibrium allocation would then involve relatively smaller shares of asset A in portfolios. Thus, rule (7) implies that:

Proposition 1. *Ceteris paribus, in an economy with relatively lower financial efficiency (i.e., a lower Ψ) equilibrium current consumption and the equilibrium stocks of liquid assets in individual portfolios are larger than in an economy with a more efficient financial system.*

Call Ψ -efficient (resp., Ψ -inefficient) the economy with high (low) financial efficiency. The two economies are hypothetically equal in all other respects. As asset A represents a financial claim on the economy's productive capital and its supply is interest-elastic (with positive but finite elasticity), rule (7) and conditions E(1)-E(4) imply that:

Proposition 2. *The Ψ -inefficient economy has a smaller equilibrium capital endowment than Ψ -efficient economy.¹⁸*

In terms of relative price structure, rule (7) and conditions E(1)-E(4) also imply that:

Proposition 3. *In the Ψ -inefficient economy capital trades at a discount as compared to the Ψ -efficient economy. The same equilibrium stock of capital is held in the two economies only if, ceteris paribus, the return on capital in the Ψ -inefficient economy is enough to compensate holders for the relative financial inefficiency.*

Note however, that:

Proposition 4. *The increase in the rate of return required to induce holders of capital in the Ψ -inefficient economy to catch up with the capital endowment of the Ψ -efficient economy is not feasible under the existing technology.*

The extent of the unfeasible region - defined by the demands for capital in the two economies and the marginal efficiency of capital - represents the cost of the relative financial inefficiency of the Ψ -inefficient economy (see Appendix II). The above propositions have clear implications for economic development policy, as they emphasize the importance of reforms to enhance financial efficiency as a way to support productive capital accumulation in emerging economies.

I.2.3 Impact of uncertainty

Uncertainty is here assumed to affect the probability distribution functions used by the agents to predict future supply innovations in the economy: a higher degree of uncertainty implies a more spread out probability density function of future supply shocks and, therefore, a larger output volatility (Appendix IV). This section takes the case of real output uncertainty, but the methodology could as well apply to monetary uncertainty (Bossone, 1997). By way of a simple analysis of the model's f.o.c.'s under the given assumptions, it is possible to assess the impact on equilibrium allocation and prices of an increase in agents' perceived uncertainty over future output shocks in an economy with incomplete trust. With utility functions featuring the properties described earlier and assuming that the agents anticipate real supply shocks to affect their consumption, one has that

$$(8) \quad , E[u'(C_r)] - u'[E(C_r)] > 0$$

where the difference of the LHS increases with the expected variability of future consumption. To take into account the *risk premium* associated with increasing consumption variability, function ϕ_C can be introduced whereby

$$(9) \quad {}_tE[u'(C_\tau)] = \phi({}_tE(C_\tau), (\sigma_\tau^\rightarrow | w_t)), \quad \phi'_C < 0, \phi'_\sigma > 0$$

Relation (2) can thus be rewritten as

$$\begin{aligned} (2b) \quad u'(Q_t^h | w_t) &= \sum_{\tau=t}^{\infty} \beta^\tau \{ [1 - d_\tau^Q(\sigma_\tau^\rightarrow | w_t, \Psi)] \phi({}_tE(Q_t^h / p_\tau^C, \sigma_\tau^\rightarrow | w_t) \prod_g R_g^Q) pr(s^c = s_\tau^c | w_t) / \sum_\tau pr(\cdot) \} \\ &= \phi(Q_t^h, p_\tau^\rightarrow, \sigma_\tau^\rightarrow, R_\tau^{Q\rightarrow}, \Psi | w_t) \end{aligned}$$

with derivatives

$$(10) \quad \phi'_Q < 0, \phi'_p > 0, \phi'_\sigma ?, \phi'_R > 0, \phi'_\Psi > 0$$

where $p_\tau^\rightarrow = [{}_tE p_{\tau+i}^C]_{i=1}^\infty$ and $R_\tau^{Q\rightarrow} = [{}_tE \prod_{\theta=i} (R_{\theta+i}^Q)]_{i=1}^\infty$ are the vectors of the expected values (as of date t) of, respectively, commodity prices and compound gross real interest rates on assets. As discussed earlier, the sign of ϕ'_σ depends on the behavior of both d^Q and $pr(\cdot)$ and thus, ultimately, on the liquidity of the asset. Note, however, that $\phi'_\sigma(L), \phi'_\sigma(B) > 0$ while $\phi'_\sigma(A) < 0$. Finally, an increase in financial efficiency increases Q 's marginal utility. It is assumed that this effect is relatively stronger for private claims, such as equity, while it is negligible for government securities which already trade at a low discount due to government guarantee (see above).

Using (2b) and positing $w_t = w^0$, rule (7) under (E1)-(E4) can be written as

$$\begin{aligned} (7a) \quad \phi(C_t^{h*}, p_\tau^\rightarrow, \sigma_\tau^\rightarrow | w^0) (p_t^{C*})^{-1} &= \phi(L_t^{h*}, p_\tau^\rightarrow, \sigma_\tau^\rightarrow, -\pi_\tau^\rightarrow | w^0) \\ &= \phi(B_t^{h*}, p_\tau^\rightarrow, \sigma_\tau^\rightarrow, R_\tau^{B\rightarrow} | w^0) (p_t^{B*})^{-1} \\ &= \phi(A_t^{h*}, p_\tau^\rightarrow, \sigma_\tau^\rightarrow, R_\tau^{A\rightarrow}, \Psi | w^0) (p_t^{A*})^{-1} \\ &= \mu_t^0 \end{aligned}$$

Note that current consumption is conditional on w^0 when $\tau > t$. From (7a), (2b) and (10), and recalling that both $(\sigma_t | w_t)$ and $pr(s^c = s_{t+1}^c | w_t)$ increase as w approaches one, it follows that an increase in w_t to $w^1 > w^0$ affects equilibrium prices since

$$\begin{aligned}
 (11) \quad \phi(C, \cdot | w^1)(p_t^{C*})^{-1} &= \phi(L, \cdot | w^1) = \phi(B, \cdot | w^1)(p_t^{B*})^{-1} \\
 &= \mu_t^1 > \mu_t^0 \\
 &> \phi(A, \cdot, \Psi | w^1)(p_t^{A*})^{-1}
 \end{aligned}$$

Recalling the invariance of B 's discount factor, the inequality in (11) is due to the differential impact of A 's discount factor on A 's marginal utility following the change in signal w . Note that, in response to the signal, the other marginal utilities in (11) all increase by an equal amount due to the expected increase in consumption variability. Clearly, at prices p^{C*} , p^{B*} and p^{A*} , and with a given current inflation rate, the new aggregate demands for consumption and assets are

$$(D1) \quad \sum_h (C^h | w^1) > Y^0$$

$$(D2) \quad \sum_h (L^h | w^1) > L^0$$

$$(D3) \quad \sum_h (B^h | w^1) > B^0$$

$$(D4) \quad \sum_h (A^h | w^1) < A^0$$

At date t , re-attaining equilibrium (E1)-(E4) from (D1)-(D4) requires instantaneous prices and inflation to adjust to the new levels $p_t^{C**} > p_t^{C*}$, $p_t^{B**} > p_t^{B*}$, $p_t^{A**} < p_t^{A*}$ and $\pi_t^* > \pi$. The new equilibrium prices reflect agents' revised expectations over future prices and interest rates, based on new information. Note that instantaneous inflation needs to increase if the marginal utility of the unremunerated L -holdings is to adjust consistently with rule (7a). Note also that, in light of the inverse price/interest rate relationship, the new equilibrium asset prices imply that: $R_t^{B**} < R_t^{B*}$ and $R_t^{A**} > R_t^{A*}$. This shows:

Proposition 5. *An expected increase in output variability drives risk-averse agents to substitute future with present consumption, and to shift their portfolio composition towards more liquid assets enabling them to absorb negative consumption shocks with minimum suboptimal asset sales. For equilibrium to be re-established in all markets, the price of current consumption and the required (equilibrium) real rates on less liquid assets have to rise, while the required (equilibrium) real rates on liquid assets have to adjust downward.*

Basically, the way uncertainty works its effects through the economy in this model is via its expected impact on the timing of asset trading and its related transaction costs. In times of higher perceived uncertainty, agents expect discounts on less liquid assets to increase when they suddenly want to make their portfolio more liquid.

In fact, there is no guarantee that the new equilibrium prices will be attained or sustainable, if attained. Risk perceptions might be such as to lead the agents to deny their money to new supply of less liquid liabilities at whatever price they are offered. Such a disequilibrium outcome is consistent with financial market rationing phenomena typical of AI models of credit and capital markets.

Finally, relations (11), (D1)-(D4) and the propositions above imply that:

Proposition 6. *Improving the efficiency of the financial system helps the economy's relative prices better absorb exogenous shocks and*

Proposition 7. *Ceteris paribus, higher financial efficiency lowers the equilibrium relative price of capital and the required premium on "catch-up" investment (see Proposition 4).*

The last proposition suggests that, especially in the context of emerging economies, there is a complementarity between financial and real sector development that can be exploited through appropriate policies, a point which today is supported by considerable empirical evidence.¹⁹

Part II. A policy view

II.1 Enhancing trust

Information limitation and asymmetries are a fact of life and agents may have strong incentives to exploit them unethically. Also, information and its use are costly and not all agents can afford them. Moreover, specialization of human activities is such that a world with *symmetric* information is not attainable, nor would it be economically efficient (which is not to deny, however, that at least in principle more information is always better than less). Indeed, a market economy is essentially based on the need of each individual in society to rely on the specialized knowledge of others as an efficient way to increase her welfare.

What matters, then, is that agents be able to rely on each other, and to have means to select counterparties they can trust with using private information efficiently and fairly. As shown in part I, the trust issue is crucial in financial transactions whereby anonymous agents trade promises. Finance can thus be seen as the complex of institutions, instruments, norms and infrastructure aimed to reduce transaction costs associated with trading promises between agents who do not trust each other fully. In this respect, financial intermediaries act as bridges of trust between agents, and their efficiency can be measured by their ability to reduce the costs involved in bridging trust gaps (consistently with the definition of financial efficiency offered in part I).

The public sector can enhance trust in finance by improving the enforcement technologies embodied in financial infrastructure (e.g., legal system, financial regulation, security in payment and trading systems). But although strengthening enforcement technologies is necessary, it cannot be the only solution since enforcing obligations becomes extremely costly if obligations run contrary to private incentives. Fundamental improvements in financial efficiency can thus be gained by eliciting good conduct as much as possible through market forces.²⁰

II.2 Trust and reputational capital

As noted, in a world with incomplete trust, agents can earn positive quasi-rents by specializing in financial intermediation between anonymous traders unwilling to trade promises directly. In terms of part I model, intermediation by good bridges of trust reduces transaction costs on the trading of promises and attracts demand for promises that would otherwise be prohibitively expensive. In a competitive environment where agents seek to discriminate between

good and *bad* bridges of trust, it pays intermediaries to earn a good reputation and to signal such reputation to the market. Where agents reward trust for honest and prudent behavior and punish untrustworthy behavior, reputation links the intermediaries' stream of future profits to their past business conduct. Good intermediaries thus accumulate *reputational capital* which conveys to the market the value of their commitment not to breach their (implicit or explicit) contracts with clients and counterparties.²¹

Operationally, the reputational capital of a financial intermediary consists of a complex of variables that *signal* the intermediary's commitment and capacity to fulfil its obligations. The most relevant variables are: the intermediary's long-term mission, its market presence and past performance, financial strength and profitability, organizational and governance structure, capacity to manage financial and operational risks, track record of compliance with legal and financial obligations, quality of service and advice delivered, quality of projects financed, quality and ethics of management and personnel, and transparency of operations, resources invested to stay in business. Other variables, external to the individual intermediaries, bear on their reputational capital and include the quality of financial regulation and supervision and the strength of law enforcement to which they are subject.

Klein and Leffler (1996) study the conditions under which the franchise of firms supplying high quality of products exceeds their one-time wealth increase from distrustful behavior (i.e., selling to customers a quality less than contracted for). They show, *inter alia*, three important results: First, they determine the price premium (above the competitive price) at which the value of satisfied customers exceeds the return to the firm from cheating, thus motivating competitive firms to honor high quality promises. This quality-assuring premium provides the supplying firm with a perpetual stream of quasi-rents whose present value is greater than the profit from cheating, that is: the *net* franchise value of the firm is positive, this being the value at loss if misbehavior puts the intermediary out of business net of the one-time gain obtainable from misbehaving.²²

Second, firms accumulate non-salvageable (productive and/or nonproductive) capital assets through which they signal to customers their commitment not to cheat. Such assets are part of the firms' reputational capital and represents the collateral that firms stand to lose if they supply less than the anticipated quality (bank capital and reserves are an example). As the reputational capital saves on the costs to evaluate trustworthiness, it gives the agents an incentive to pay a premium to the firms for receiving the desired quality. In the case where the supplying firm is a financial intermediary, such a premium reflects the value to the agents from minimizing the cost of trading promises under incomplete trust.²³ investors accept to pay a trust-assuring premium for being able to entrust the intermediary agents with managing informational asymmetries vis-à-vis fund-

takers.²⁴ In fact, the intermediaries may extract extra-rents from fund-takers, too, in the form of higher than competitive prices, as they enable them to economize on their reputational investment in non-salvageable assets. This is consistent with the evidence reported by Rajan and Zingales (1999) indicating that firms operating in more developed financial sectors undertake less fixed capital formation.²⁵

Third, as prices below the quality-assuring level decrease the demand for high quality output, Klein and Leffler show that, under free market entry, firms compete on non-price terms and seek to win customers by signaling a higher reputational capital. Under their model, it can be shown that reputational capital accumulates (and new entries occur) within the industry to the point where the business *net* franchise value is competed away.

Abstracting from ethical considerations (which, of course, influence the incentive structure of individual intermediaries), what precedes suggests that investing in reputational capital is meaningful only in repeated-game contexts with long business time horizons.²⁶ Repeated and extended dealings must take place over a period long enough to ensure that the net franchise value is positive.²⁷ Designing incentives to promote investment in reputational capital in the financial sector requires to consider these features.

II.3 Incentives

The discussion in this section centers on incentives to *induce* trustworthy behavior in the financial sector by soliciting agents' self-interest in ways that generate self-sustaining enforcement mechanisms of good behavior. Areas of public policy to strengthen financial infrastructure are not dealt with here, although - as noted - their omission should not be understood as neglecting their importance.

II.3.1 Investing in reputational capital: the role of regulation

Increasing the franchise of financial institutions is a necessary first step of financial sector reform. Only a positive net franchise value from intermediation may attract investment in reputational capital from financial institutions. Use of mild regulatory *restraints* on market competition might increase the franchise value of domestic institutions, especially in least developed countries and in those emerging from long periods of financial repression, or in deep financial crisis and restructuring their financial sector (see Hellmann and Murdock 1995, and Hellmann, Murdock and Stiglitz 1994, 1995, 1996).

In the banking sector, restraints such as (market-based) deposit rate ceilings and restrictions on market entry may have large rent creation effects that would allow banks to raise

profits during the initial phase of reform. Hellmann *et al.*, cit., show that the degree of restraints necessary to produce significant rents is such that would not generate large financial market price distortions. Also, to the extent that banks respond positively to restraints by investing rents in reputational capital, price distortions would be partly eliminated by lower risk. In terms of Klein and Leffler's framework, restraints correspond to determining the trust-assuring price premium exogenously while preventing free market entry. As a result, accumulation of reputational capital is not induced by competition and must therefore be forced by regulation (see below).

Restraints should be accompanied, and eventually replaced, by restrictions on market entry/exit based on reputational capital criteria. With exogenous reputational capital and competitive or contestable markets, trust-assuring price premiums become endogenous and restraints are no longer desirable. Reputational capital criteria could include minimum requirements on financial capital, organizational, operational, and governance structures, risk-management capacity, and conditions for *fit and proper* owners and managers. Licensing should imply serious initial commitments from owners and managers wishing to enter the market, showing their strong commitment to forsake one-time rent options from cheating or from behaving imprudently. Issue of subordinated uninsured debt (see II.3.5) and publicly observable discretionary guarantees (Boot *et al.*, 1993) could also be required by regulation as signaling devices for reputational capital and its dynamics.

Where restraints apply, reputational capital criteria could be used by regulators to make markets contestable: licenses could be granted (transferred) to owners and managers on the basis of their plans for a strong reputational capital. Transparent reputational capital criteria could be used by regulators to decide on approval of changes in ownership and management resulting from market takeovers, mergers, and reorganizations.

II.3.3 Investing in reputational capital: the role of economic capital

Economic capital is a core component of the reputational capital of financial intermediaries. The capital adequacy ratios of the Basle Accord are a first essential step to induce banks to accumulate capital vis-à-vis risks. As is well known, however, the static approach embodied in the Accord may cause inefficiencies in resource allocation (Nickerson, 1995), and result in either inadequate economic capital or undue costs on banks. Moreover, if capital ratios are perceived exclusively as regulatory requirements, compliance with them could induce to self-complacency from the intermediaries and to misleading signals to investors.

As the financial system develops in emerging economies, banks in these countries should be advised to replace static capital ratios with more dynamic (and tailor-made) methods that correlate financial capital more closely to risks. This would render the effects of risk

diversification more visible and measurable, and strengthen the incentives to portfolio diversification. More in general, it would make clearer to banks the trade-off between the cost of raising extra capital funds and the marginal reputational gain associated with additional financial capital and would thus induce banks to internalize decisions on capital ratios.

As more dynamic risk-management systems are introduced, regulation should: 1) require banks to disclose their market and credit risk position; 2) require banks to raise capital if this is less than the reported risks; 3) prevent banks from underestimating their potential losses by requiring them to put up extra capital if actual losses exceed the *ex-ante* estimations (i.e., restore their capital or maintain higher ratios as a penalty).²⁸ Ultimately, regulators would be less concerned with determining capital ratios and specialize in assessing the methodologies used by banks to determine their own ratios.

II.3.3 Investing in reputational capital: the role of self-regulation

To the extent that the franchise of intermediaries interacting in financial markets can be very sensitive to their mutual behavior, they have an incentive to undertake *self-policing* activities through which they can monitor each other, elicit voluntary good conduct, and sanction misbehavior.²⁹ Increases in franchise value and incentives to build reputational capital may result from the interest that private-sector agents take in establishing long-term mutual bonds to enforce honest and prudent behavior through self-policing.

Self-policing arrangements may develop within financial communities (Goodhart, 1988).³⁰ In some cases, they evolve into fully fledged self-regulatory organizations (SROs) with internal statutory rules (regarding admission and sanctions), financial resources, and formal structures involving shareholders, managers and employees, codes of conduct, and oversight procedures involving rules of conduct and information disclosure (Glaessner, 1993). Many countries today adopt SROs in payments and securities markets. SROs may range from interbank deposit markets, to wholesale and retail payment systems, securities trading and stock exchanges, securities lending and settlement clearinghouse services, deposit insurance, and credit information sharing systems.

Incentives in financial SROs - especially in interbank payment and settlement systems - can be strengthened by members agreeing to pre-committing resources - in the form of mutual lending obligations or collateral pooling - that would be mobilized if one or more members run into illiquidity or insolvency problems. Pre-commitments to liquidity- and loss-sharing arrangements generate incentives for each member to monitor the others, agree on and enforce rules, and sanction misbehavior. Liquidity and loss-sharing arrangements protect market participants from the systemic consequences of failures of one or more financial institutions.

They thus afford supervisors some higher degrees of freedom in deciding whether to let insolvent institutions fail, and enhance the certainty of government exit policies. To the extent that greater certainty lessens agent expectations of government bailouts or forbearance, investors are faced with stronger incentives to good conduct and careful monitoring.

Some problems may complicate the setting up of financial SROs in developing countries. Scarcity of institutional resources may constrain the quality of oversight, and the lack of reasonably homogenous institutions could impede the formation of internally balanced structures. Also, SROs might transform themselves into cartels and jeopardize competition. Even so, because of their specialized knowledge and self-interest, SROs are better placed than government bureaucracies to design rules consistent with the features of their business, to keep their operational institutional process apace with progress, and to improve their business standards. Also, as information is vital to each SRO member, the SRO setting is better positioned than government agencies to achieve enforcement of disclosure rules through peer monitoring.

Government has a key role to play in supporting the formation of financial community ties along sound self-regulatory principles. It could delegate to domestic financial institutions the task to form industry groups for governing and running specialized markets. Government should monitor SRO operations and intervene if their action deviates from purposes. Government should also ensure that SRO rules and practices are compatible with fair market competition.

Finally, the efficiency of dispute resolutions and adjudication processes is crucial for the success of SROs.³¹ Government should not preclude (indeed, it should encourage) private judicial mechanisms and institutions that serve to enforce good conduct. In a number of cases, out-of-court procedures have been successfully employed to govern corporate restructuring processes (Claessens, 1998).

II.3.4 Signaling reputational capital: the role of information

In a competitive environment, good-quality information on financial intermediaries can stimulate investment in reputational capital as it increases the franchise of intermediaries who achieve higher reputational standards. In the trust-related context developed above, information is the vehicle that conveys to the market knowledge about the reputational capital of individual intermediaries. A critical component of financial sector reform is thus the improvement of the information generation and dissemination process. The government can help a private market for information to develop.

Provided that financial institutions invest in reputational capital and investors optimize their risk/return combinations, there are incentives for information to be searched and supplied by specialized agents.³² On the demand side, sensitivity to capital losses motivates investors to use

information to select well-reputed financial intermediaries. Government should exploit this sensitivity to design market devices for raising information demand (see section II.3.4). For example, where there is a subordinated debt requirement for banks, healthy banks have an incentive to reveal their true reputational capital status so that subordinated-debt holders facing aggregate shocks, and otherwise unable to discriminate good from bad banks, do not indiscriminately sell their holdings.

Market demand for information, in turn, prompts intermediaries seeking to enhance their reputation to provide reliable information. Increasing extended dealings may strengthen this incentive, as intermediaries with large reputational capital seeks to exploit extended dealings by disclosing more information to their clientele (Hellmann *et al.*, 1995). One way of doing this is by allowing intermediaries to operate across a broad range of market and maturity segments, since reputational capital in one segment affects their franchise in the others. This increases the franchise of well-reputed intermediaries and give them an incentive to act prudently and honestly in the new segments.

The demand and supply factors for information induce agents to specialize in information provision. Examples are credit bureaus, rating agencies, and securities underwriters. Credit bureaus, for instance, improves the signal from borrowers' reputational capital and increases lending volumes to safe borrowers that would otherwise be priced out of the market due to adverse selection (Jappelli and Pagano, 1991). Matching or referral services - such as the well-known accreditation schemes in the US health sector - could be provided by private agents to inform clients about quality, terms, and conditions of services from individual intermediaries. Financial referral services could rely on information disseminated by agencies or on information made available by the intermediaries themselves, as well as on clients' evaluations, opinions and satisfaction rating reports. Referral services would supply a channel for intermediaries to advertise their reputational capital to potential clients on the basis of tested and verifiable information.³³

Providers of customized information might operate for a profit and sell specialized reports. If information is proprietary, its production can be profitable. Providers of uniform information might otherwise organize themselves as *consumer unions* or *producer cooperatives* and be remunerated by their respective communities (Klein, 1997). In the case of credit bureaus, increasing returns associated with additional participating banks tend to make the systems operate as natural monopolies (Jappelli and Pagano, *cit.*); in this case, they might organize themselves as SROs.

Government can support information provision in direct ways. It could subsidize one or a few private enterprises until a market takes off. Through SROs, government could induce private-

sector financial intermediaries to set up information services for their mutual benefit and for clients. Government could initially provide information services directly, as in the case of the Central de Deudores in Argentina, and later let the private sector take over (Calomiris, 1997; World Bank, 1998). Government could also provide infrastructure that would ease the flow of private information. It could disseminate information on bank credit risk collected in its banking supervisory capacity and establish a centralized registry for collateral.³⁴

II.3.5 Signaling reputational capital: the role of private risk-takers

As noted, sensitivity to capital losses motivates investors to use information to select well-reputed financial intermediaries. In the banking sector, deposit insurance schemes could be designed so as to induce much closer attention from (both large and small) depositors on the true status of their banks.³⁵ This would be achieved, for instance, if insurance premiums were correlated with bank risks and made known to depositors, since a higher premium would indicate a lower reputational capital. Such an incentive would be further strengthened if the insurance was provided by competing private insurers, as these would seek to correlate premiums with risks as closely as possible and thus generate a strong demand for good-quality information from banks. Similarly, limited insurance coverage would likely induce depositors to assess more carefully their banks. Another strong incentive would hold if depositors were asked to co-pay insurance premiums correlated with bank risks, and if premiums were to vary with the extent of insurance coverage purchased.

Another market-based signaling device for reputational capital would be provided by requiring intermediaries to finance a small portion of their non-reserve assets with subordinated debt (uninsured certificates of deposits) bearing an interest rate not greater than the riskless rate plus a given spread and held by *well-informed* market agents (Keehn, 1989; Wall, 1989; Calomiris, 1997). Subordinate-debt holders would have an incentive to monitor debtors' compliance with the risk-cap requirement and to sell at discount the debt of under-performing institutions. This device would supply the market with reliable signals on the intermediaries' reputational capital, provided there was a liquid secondary market for the subordinated debt and that the debt-issue requirement was credible and effective in the first place.³⁶

Appendix I

Solution to household plan (3)-(6)

Maximand (3) expresses two trade-off (utility) relations: the first is between current consumption and options to future consumption; the second is between the store-of-value *enhancing capacity* and the liquidity of the future consumption options held in the portfolio. To solve plan (3)-(6), Bellman's equation can be written as

$$(A1) \quad V(L_{\tau-1}^h, B_{\tau-1}^h, A_{\tau-1}^h, R_{\tau-1}^w, Y_{N\tau-1}^h, [P]_{\tau-1}) = \underset{C, L, B, A}{\text{Max}} \{U(C_{\tau}^h, L_{\tau}^h, B_{\tau}^h, A_{\tau}^h) \\ + \beta V(L_{\tau+1}^h, B_{\tau+1}^h, A_{\tau+1}^h, R_{\tau+1}^w, Y_{N\tau+1}^h, [P]_{\tau+1})\}$$

where:

$[P]$ is the price vector of consumption-commodity and assets;

$(L_{\tau-1}^h, B_{\tau-1}^h, A_{\tau-1}^h, R_{\tau-1}^w, Y_{N\tau-1}^h, [P]_{\tau-1})$ is the state of the economy at date τ ; and

R^w is the real rate of return on the household's portfolio.

The Euler equation for $(C_{\tau}^h, L_{\tau}^h, B_{\tau}^h, A_{\tau}^h) \equiv [O_{\tau}^h]$ is thus

$$(A2) \quad U'(C_{\tau}^h, L_{\tau}^h, B_{\tau}^h, A_{\tau}^h) = \beta U'(C_{\tau+1}^h, L_{\tau+1}^h, B_{\tau+1}^h, A_{\tau+1}^h)(1 + R_{\tau+1}^w)$$

Condition (A2) establishes the optimal intertemporal path for consumption and asset holdings. But what is of interest to us is the intra-date composition of vector $[O_{\tau}^h]$, that is, the household's intra-date allocation of resources to current consumption and individual assets. The problem can be framed as in plan (3)-(6) in the text, here reported for convenience:

$$(3) \quad U^H = \underset{C, L, B, A}{\text{Max}} \quad E \sum_{\tau} \beta^{\tau} U(C_{\tau}^h, L_{\tau}^h, B_{\tau}^h, A_{\tau}^h) \quad \text{s.t.}$$

$$(4) \quad p_t^C C_t^h + z_t^h \leq Y_{Nt}^h + \sum_{Q=B, A} r_{t-1}^Q P_0^Q Q_{t-1}^h \\ + \sum_Q [d^Q \max(0, P_{t-1}^Q Q_{t-1}^h - P_{t-2}^Q Q_{t-2}^h) - d^Q \max(0, P_{t-2}^Q Q_{t-2}^h - P_{t-1}^Q Q_{t-1}^h)]$$

$$(5) \quad C, L, B, A \geq 0$$

$$(6) \quad \lim_{\tau \rightarrow \infty} L_{\tau} = \lim_{\tau \rightarrow \infty} B_{\tau} = \lim_{\tau \rightarrow \infty} A_{\tau} = 0$$

Applying Lagrange method to plan (3)-(6) and using equation (2)

$$u'(Q_t) = u'(Q_t | w_t) =$$

$$= \sum_{\tau} \beta^{\theta} \{ (1-d^Q) [E[u'(Q_{\tau} / p_{\tau}^C) \Pi_{\theta} R_{\theta}^Q] pr(s^c = s_{\tau}^c | w_{\tau}) / \sum_{\tau} pr(\cdot, \cdot)] \}$$

yield the following first order conditions:

$$\begin{aligned} V'(C_{\tau}^h) &= \beta^{\theta} (p_{\tau}^C)^{-1} u'(C_{\tau}^h) - \mu_{\tau} = 0 \\ V'(L_{\tau}^h) &= \beta^{\theta} u'(L_{\tau}^h) - \mu_{\tau} = 0 \\ V'(B_{\tau}^h) &= \beta^{\theta} (p_{\tau}^B)^{-1} u'(B_{\tau}^h) - \mu_{\tau} = 0 \\ V'(A_{\tau}^h) &= \beta^{\theta} (p_{\tau}^A)^{-1} u'(A_{\tau}^h, \Psi | w_{\tau}) - \mu_{\tau} = 0 \\ \mu_{\tau} &\geq 0 \\ \mu_{\tau} \{ &p_{\tau}^C C_{\tau}^h + z_{\tau}^h - Y_{Nt}^h - \sum_{Q=B,A} r_{t-1}^Q p_0^Q Q_{t-1}^h \\ &- \sum_Q [d^Q \max(0, P_{t-1}^Q Q_{\tau-1}^h - P_{t-2}^Q Q_{\tau-2}^h) - d^Q \max(0, P_{t-2}^Q Q_{\tau-2}^h - P_{t-1}^Q Q_{\tau-1}^h)] \} = 0 \end{aligned}$$

implying that at planning date t , for given current and expected values of σ' , β , π , r^B and r^A , the household selects the allocation $[O_{\tau}^{h*}] \equiv (C_{\tau}^{h*}, L_{\tau}^{h*}, B_{\tau}^{h*}, A_{\tau}^{h*})$ which at each date τ satisfies the optimal intra-date rule

$$(7) \quad u'(C_{\tau}^{h*})(p_{\tau}^C)^{-1} = u'(L_{\tau}^{h*}) = u'(B_{\tau}^{h*})(p_{\tau}^B)^{-1} = u'(A_{\tau}^{h*}, \Psi | w_{\tau})(p_{\tau}^A)^{-1} = \mu_{\tau}$$

Thus, with given commodity and asset prices, rule (7) determines optimal individual demands for C , L , B and A , at every date and requires each household to equate at every instant the *weighted* marginal utilities derived from allocating the marginal resource unit to consumption commodity and assets (weighted with the inverse of their own current market price). Consistency of rule (7) with the solution to the household's dynamic problem can be seen to hold by showing that no allocation $[O_{\tau}^{h*}]$ exists which solves condition (A2) while violating rule (7): with rule (7) violated, an allocation $[O_{\tau}^{h**}] \succ [O_{\tau}^{h*}]$ consistent with (7) can always be attained within the given constraints, that yields a higher value for (3) at no extra cost to the household and solves (A2).

Appendix II

The cost of (relative) financial inefficiency

The meaning of Proposition 4 can be seen more clearly in Figure 1, where D_1 and D_2 are the demand schedules for capital K as a function of interest rate r in the Ψ -inefficient and Ψ -efficient economy, respectively, and schedule $k(K)$ is the marginal return on capital as a function of capital stock. (As before, claims on K are represented by holdings of asset A in household portfolios). D_1 lies entirely above D_2 since, *ceteris paribus*, asset holders in the Ψ -inefficient economy require a premium $(r^+ - r^*)$ on the rate of return for holding the same stock of capital as in Ψ -efficient economy. The equilibrium stock in the former (K^-) is therefore lower than in the latter (K^*) and achieving K^* requires an increase in the rate of return along D_1 above the feasible region delimited by k . The unfeasible region defined by $r^- r^+ K^- K^*$ represents the relative cost of the Ψ -inefficiency.

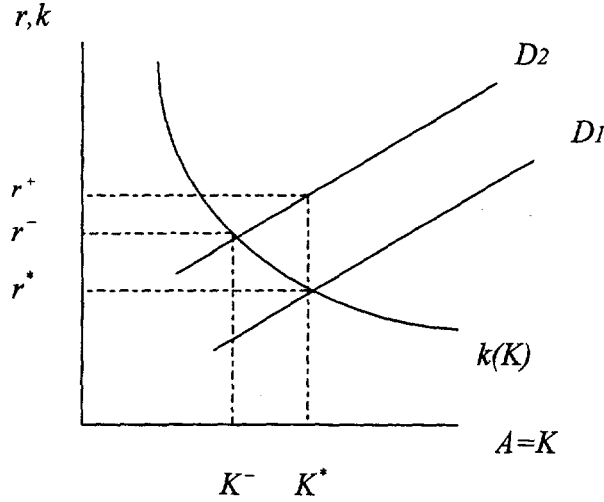


Figure 1.

Appendix III

Asset realization and price discount

As the date of asset realization falls closer to planning date t , the risk of suboptimal sale increases. There is thus a link between the probability of date-event s_t^c , the proximity of τ to t , and the size of d^Q . To show this, consider two extreme cases by solving eq. (2) for some critical values of d^Q and $pr(\cdot)$, assuming Q has maturity T , $d^{Q*} = 0$, r^Q is constant, and $\pi = 0$.

Case 1): if at time 0: $pr(s^c = s_t^c) = 0, \tau = 0, T - 1$, that is, no shock to consumption is anticipated during the life of the asset (which is equivalent to the case where $pr(s^c = s_t^c) = 1$), and the agent is certain that she will not have to liquidate Q at a discount ($d^Q = 0$), the current marginal utility of Q is $u'(Q_0) = \beta^T {}_0 E[u'(P_0^Q Q_0 / p_T^c) R^{Q^T}]$

Case 2): If at time 0: $pr[(s^c = s_t^c), \tau: \tau / \Delta t_Q^* \rightarrow 0] = 1$, that is, a shock to consumption is anticipated for date τ , and τ is such that the agent will have to sell the asset suboptimally, then $d^Q \rightarrow 1$ and $u'(Q) \rightarrow 0$.

These examples represent benchmarks for more realistic cases. For, at times of higher variability of, say, real income, asset price discounts are likely to increase to the extent that the subjective probability of having to realize illiquid assets suboptimally at each date is higher. In such cases, the current marginal utility of the assets involved would decrease.

Appendix IV

News, signals, and uncertainty

This approach generalizes the one adopted by Giovannini (1989) to model anticipated shocks. Use x_t to indicate the vector of stochastically-independent real output shocks to the economy. At each date, the agents observe the realization of x and try to anticipate future shocks by using (*i.i.d.*) current information $w' \in \Omega$. The agents operate a transformation T of w' such that $T: w' T \in (\Omega \otimes \mathbb{R}) \rightarrow w \in [0,1]$, which associates to every single bit of information w' a real number ("signal" w) in the interval $[0,1]$. In every period the evolution of variable y is governed by the following (conditional) probability distribution function:

$$(A1) \quad pr(x_t | w_t) = \sum_n w_{nt} pr_n(x_t)$$

Where the w_{nt} 's are generated by the function $W: w_t \in [0,1] \rightarrow (w_{nt} \in \mathbb{R}^n)$ and satisfy:

- 1) $0 \leq w_{nt} \leq 1, \sum_i w_{it} = 1$
- 2) $\lim_{w \rightarrow 1} \max(w_{nt}) = 0$ and $\lim_{w \rightarrow 0} \max(w_{nt}) = 1; \forall t, n \in \mathbb{N}$

The w_{nt} 's provide a weight structure that is specific to the signal received at each point in time. The greater the uncertainty perceived by the agent, the lower the value of highest weight attributable to the probability of any given shock. The structure of weights associated to every signal by function W determines a probability distribution for each shock x . Such distribution is drawn from a set of distribution functions $pr_n(\cdot)$'s obeying the following restrictions:

- i) $E(x_t pr(x_t | w_t)) = E(x_t), \forall w$, that is, all distributions are mean-preserving;
- ii) $pr_k(x_t | w_t) - pr_j(x_t | w_t) = MPS(x_t), \forall k, j$, that is, the distribution spreads are mean-preserving (Rothschild and Stiglitz, 1970)
- iii) $\lim_{w \rightarrow 1} [pr(x_t | w_t) - pr(E(x) | w_t)] = 0$, that is, the probability density function of any given shock x_t becomes more spread out as the signal approaches one.

The rationale for this formal structure is that for any given signal received, the agent forms a specific *conjecture* as to the possible occurrence of a future supply innovations. The structure of weights assumed represents the degree of belief (or confidence) that the agent attaches to such conjectures. The value of each received signal w reflects the degree of uncertainty perceived by the agents: as w increases, the weights change so as to make any conjecture on future shocks weaker and, thus, any prediction more tenuous.

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¹ *And Now... The Unfiltered, Unedited News*, The Washington Post, Outlook Section, Sunday, B5, Feb. 28, 1999.

² See the debate on the Post Keynesian Journal of Economics between Dymski (1992, 1993), van Ees and Garresten (1993), Neal (1996), Crotty (1994), Fazzari and Variato (1996).

³ Complementary to this definition of trust is that offered by Gambetta (1988): "Trust (or, symmetrically, distrust) is a particular level of subjective probability with which an agent assesses that another agent or group of agents will perform a particular action, both *before* he can monitor such action (or independently of his capacity ever to be able to monitor it) *and* in a context in which it affects its own action." (p. 217).

⁴ See, for instance, the experience with the rotating saving and credit associations in rural and urban communities of developing countries (von Pischke, 1990).

⁵ The expression is from Klein (1997).

⁶ This section draws on my previous works on this issue (Bossone 1995, 1997).

⁷ In an Arrow-Debreu setting, where exchange contracts are underwritten by the agents at the initial date of the market process and executed subsequently at the stipulated dates, there is an incentive for not fully trustworthy agents to renege on forward delivery commitments once they have received spot deliveries. The introduction of a money instrument could replace trust: in Gale's story, a government-issued security could be distributed among the agents at the initial date of the market process and demanded back at the expiration of the contracts. The security would be used in exchange for commodity deliveries: agents with forward obligations to deliver commodities would have a strong incentive to be compliant, since they would otherwise be unable to fulfill their obligations with the government.

⁸ For references to the literature on money and trust, see Bossone (1997).

⁹ Important pioneering work on the issue of recognition or identification costs in commodity and money exchange, which I happened to notice only recently, has been done by Alchian. See especially his article *Why Money?* in his collection of selected works (1977), Ch. 4, 111-23.

¹⁰ The *quality* of an asset reflects the asset's liquidity and store-of-value capacity. To assess quality, the agents need information on: *i*) the adherence of the asset's ask-price to its fully informational level, which in turn reflects the asset's relative scarcity (in case of a commodity), or its marginal efficiency (in case of a capital good); *ii*) the adherence of the asset's characteristics to those claimed by the seller; *iii*) the market where the asset is traded.

¹¹ Transaction costs here thus refer to the costs incurred by the agents to: *i*) search for trustworthy counterparts to trade; *ii*) assess the quality of the assets; *iii*) settle legal and property issues; and *iv*) monitor and enforce contracts. This is in line with North's (1990) definition of transaction costs as "the costs of measuring the valuable attributes of what is exchanged and the costs of protecting rights and policing and enforcing agreements" (p. 27).

¹² Interest rate r^Q reflects the stream of future coupon payments on Q , the expected asset prices changes, and future inflation and risk premiums.

¹³ In the following, all that refers to asset sales applies equally to asset purchases.

¹⁴ This concept draws on, and integrates, Lippman and McCall's (1986) concept of *optimal search time*.

¹⁵ Note that date-events s_t^c are mutually independent across t so that $\sum_t pr(s^c = s_t^c) = 1$ does not necessarily hold. At an extreme, for instance, one could have that $pr_t(\cdot) = 1$ for each and all t 's.

¹⁶ The production technology is assumed to use no labor inputs.

¹⁷ Framed in the context of trust-related transaction costs, the absence of a legal requirement on B 's use as a means of payment explains why B trades at a discount notwithstanding agents' certainty as to its redemption at maturity.

¹⁸ Elsewhere, I have offered a multi-sector, circuit-type sequential framework to explain how in a decentralized-decision context finance can prevent liquidity from flowing from sources to users and constrain capital accumulation even if sufficient saving is produced (see Bossone, 1998). The model above, although far less articulated than the circuit framework, has the advantage of deriving relevant stock-flows results in an explicit transaction-cost setting.

¹⁹ See Bossone and Promisel (1998) for references.

²⁰ Bossone and Promisel (1998) and Bossone (1998) argue that appropriate incentives can induce trustworthy behavior from rational agents, while improving the economy's overall efficiency/stability tradeoff. They also argue that incentives-based institutions may complement administrative action especially in developing economies with a long past of heavy financial repression, large involvement of the state in the financial sector, and severe institutional resource constraints.

²¹ In terms of the model presented in part I, where intermediaries are not explicitly introduced, investments in reputational capital augment financial efficiency parameter Ψ , reduce the discount factors d on traded assets, and increase asset trading and liquidity.

²² Klein and Leffler show that this premium exists under fairly general assumptions on firm production cost structure.

²³ Spreads earned by financial intermediaries reflect such premiums. If savers' foregone value from paying spreads is at all preference-revealing, it must somehow imply that such value is less than the cost to them for undertaking direct financial relationships with fund end-users.

²⁴ To be sure, in some cases (such as, for instance, large and highly rated industrial corporates) fund-users can accumulate enough reputational capital as to have direct access to fund-sources, but this cannot be generalized to the plurality of agents for which the trust gap requires instead the use of specialized intermediaries. Terlizzese (1988) develops a game-theoretic model where intermediaries build up reputation to reduce agency costs and attract more deposits. Reputation derives from observing the intermediaries' track record on servicing deposit debt contracts. Although not explicitly indicated in Terlizzese's model, the capital value of such reputation reflects the intermediaries' convenience to forego potential gains from cheating depositors.

²⁵ For a theoretical explanation of this finding, based on transaction costs relating to incomplete trust, see Bossone (1999).

²⁶ Klein and Leffler point out that a cooperative solution to the game exists if one assumes either a an infinitely long game or a game with finite but uncertain length.

²⁷ An extended dealing occurs when a supplier's customer shares information with other agents on the quality of service received. Through extended dealings, the reputational capital of an agent can be assessed prior to dealing with her. In financial markets, institutions with a high franchise value seeks to exploit extended dealings by disclosing more information to their clientele (Hellmann *et al.*, 1995).

²⁸ These points were suggested to the author by Charles Calomiris.

²⁹ The term "self-policing" refers to the capability of a system of private-sector agents to induce compliance with common rules of conduct from each agent, without resorting to exogenous rule enforcing mechanisms. Self-policing can either be the result of agents having incentives to undertake behavior that conforms to the collective interest, or the outcome of agents having an incentive to mutually monitor behavior. Suggestively, Klein, 1997 (Introduction), talks of self-policing being the work of an "invisible eye" (italics added).

³⁰ Spontaneous self-policing arrangements can be found in the history of international trade and commercial law, public security and maintenance of public services, and commercial bank clearinghouses. See Bossone and Promisel (1999), and the literature therein referred to. In developing countries, such arrangements are common for governing and managing natural resources (Ostrom, 1990). Self-policing arrangements allow participants to undertake transactions that would otherwise be unprofitable due to high transaction costs. Conditions for successful self-policing arrangements, as indicated by the literature, are reported in Bossone and Promisel, *cit.*

³¹ As the examples from history show, self-policing arrangements have successfully governed themselves even in the absence of coercive power of Government. Members formed their own courts to adjudicate disputes, and courts' decisions were accepted by members under the threat of reputational capital losses. "Private" adjudication schemes guaranteed speed, informality and technical competence. The adjudicative procedures and the rules adopted by the courts were designed to facilitate commercial interactions. The importance of legal certainty for growth is assessed in recent studies by La Porta *et al.* (1996, 1997), and by La Porta *et al.*, (1998).

³² Avery *et al.* (1999) identify pricing and incentives mechanisms that operate through computerized markets and induce efficient provision of evaluations.

³³ In terms of Klein and Leffler's model, referral agents would save on intermediaries' costs to accumulate non-salvageable assets.

³⁴ The monthly report "Financial Information" of the Chilean Superintendency of Banks and Financial Institutions provides an example of public disclosure of bank credit risk (see Honohan, 1997).

³⁵ Martinez Peria and Schmuckler (1998) suggest that information strengthens market discipline in the banking sector by allowing depositors to select banks according to their financial strength, quality of services, portfolio diversification and risk composition.

³⁶ For this purpose, banks should not be allowed to purchase their own debt, or to overprice debt with side-payments to debtholders (Calomiris , *cit.*).

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